AVHRR LTDR

Burned Area

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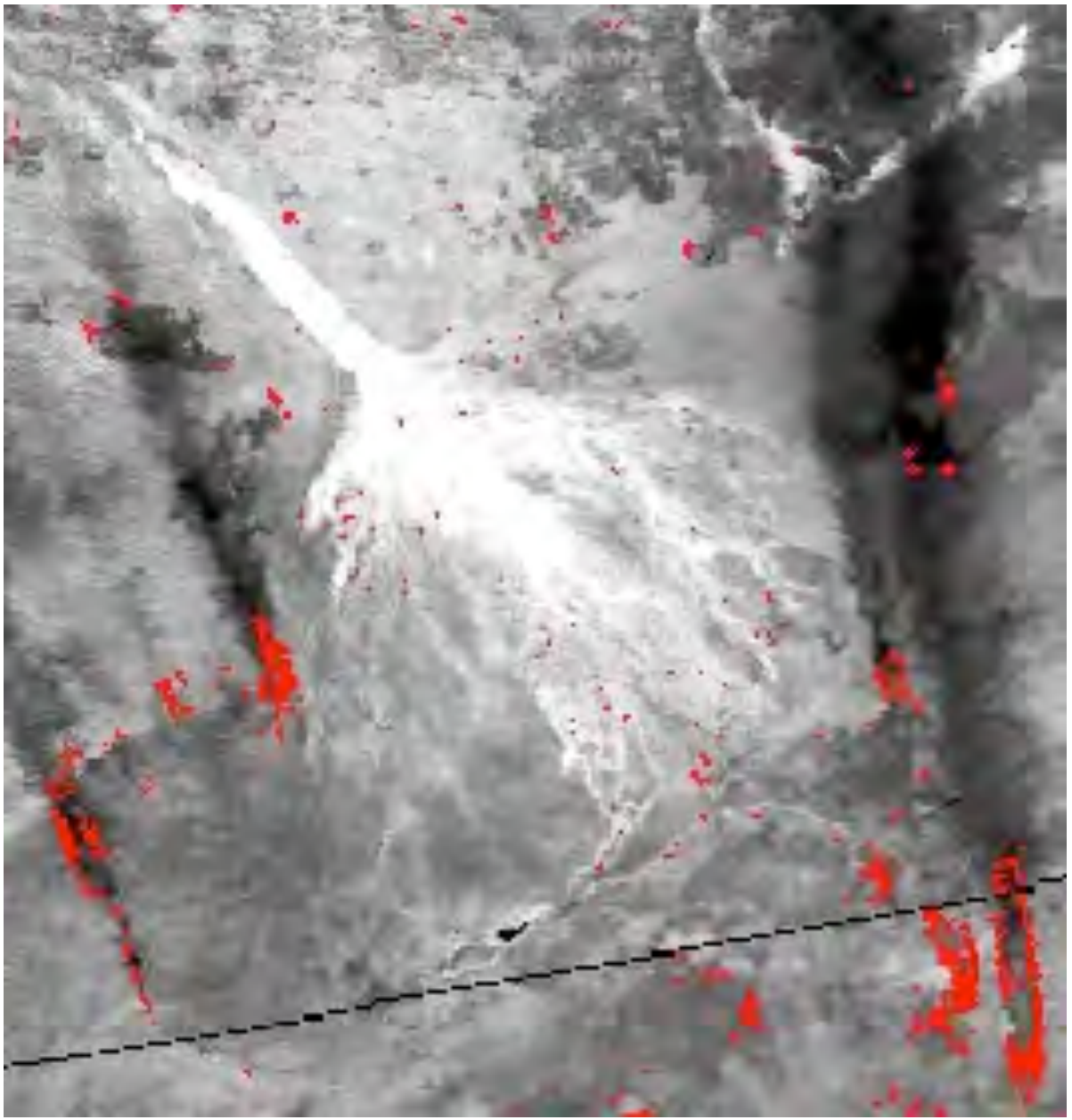
Heritage:

burned area statistics estimated from active fire detections:

simple counts

or calibration



AVHRR active fires (red) on NDVI Okavango Delta, Botswana, September 6th 1989

Our analysis also highlights shortcomings in the currently available processed AVHRR record and current generation of global burn scar detection algorithms. Improvements in both areas should lead to more reliable measures of actual area burned, to complement the existing capability, as reported here, concerning characterization of location and timing of major fire events.

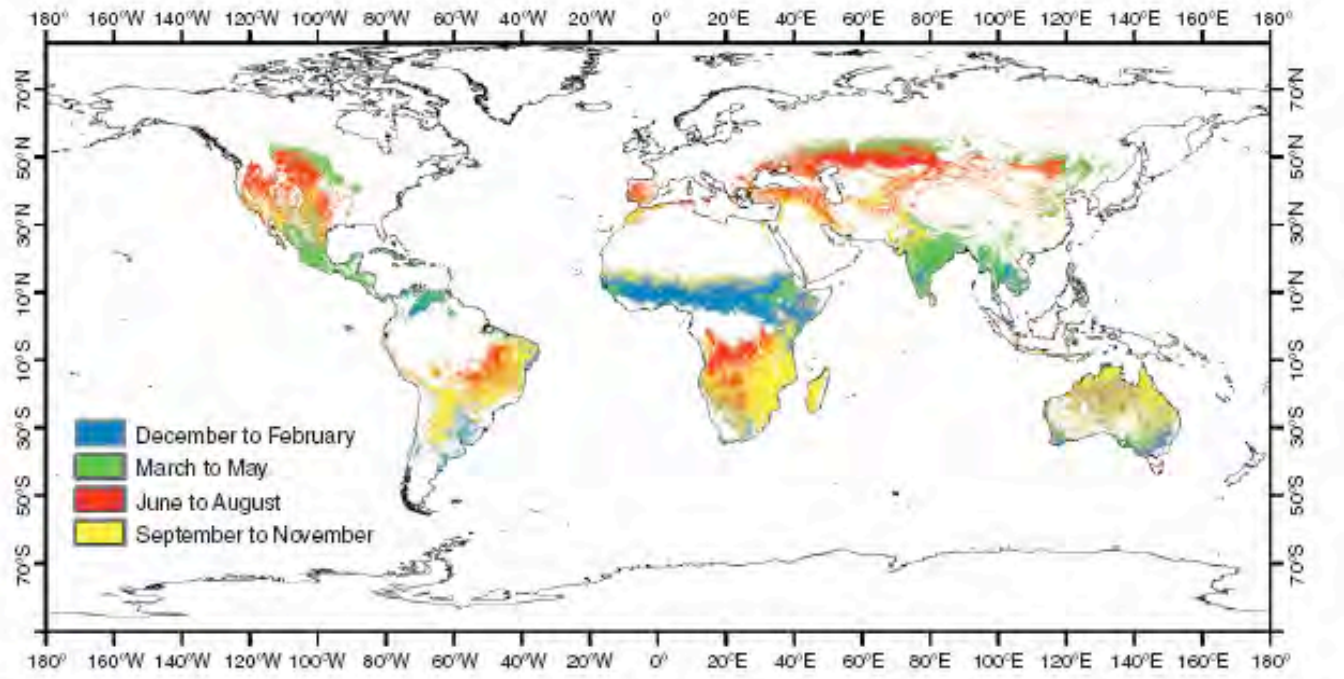


Fig. 4 Global fire activity seasonal cycle. This figure represents the seasonal distribution of the fire activity obtained from the accumulated spatial–temporal distribution of the global burnt surface products for the period 1982–1999.

Characterising interannual variation in global fire calendar using data from Earth Observing satellites, Carmona-Moreno, C., Belward, A., Malingreau, J.P., Hartley, A., Garcia-Alegre, M., Antonovskiy, M., Buchshtaber, V., Pivovarov, V. **2005**. *Global Change Biology*. **11**(9), 1537-1555

Large Area Mapping Issues

- Spectral, Spatial, Temporal characteristics of burned areas differ as a function of the
  - pre-fire: vegetation, soil, composition & structure
  - fire behavior: combustion completeness, sub-pixel fraction burned, ash/charcoal reflectance, surface/crown fire
  - post-fire: vegetation regrowth/mortality, char/ash dissipation

- At reflective wavelengths burned areas can be confused spectrally with non-burning phenomena
  - cloud & relief shadow
  - wet and flooded surfaces
  - agricultural harvesting, deforestation
  - snow melt
  - certain types of rapid veg. senescence

- At thermal wavelengths difficult to robustly differentiate burned from unburned surfaces due to the numerous processes controlling emitted radiation, diurnal variations of these, and emissivity variability

Mapping Methodologies

- Definition of the magnitude of spectral *change* associated with the conversion of vegetation to burned vegetation is **critical**.

- Thresholds have been defined by

  – examination of the frequency distribution of the data used to map burning (Barbosa *et al*., 1999, Carmona et al. 2005)

  – comparison of the data used to map burning with contemporaneous active fire detection results (Roy *et al*., 1999; Fraser *et al*., 2000)

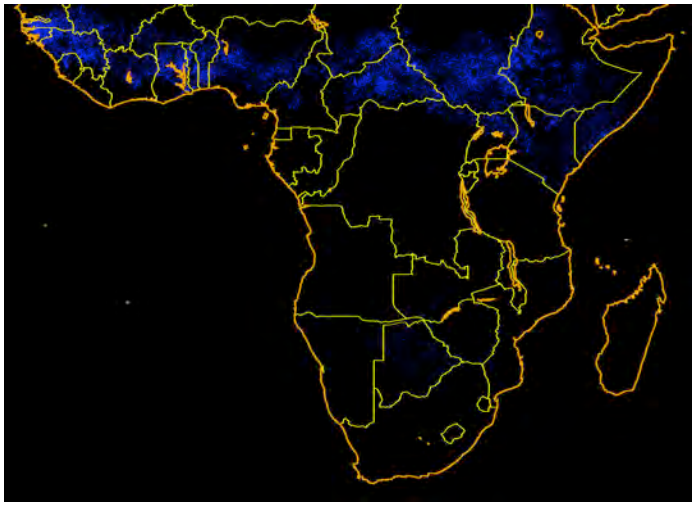
  – classification tree approaches (Stroppiana *et al*., 2002; Silva *et al*., 2002)

  – use of a semi-empirical reflectance model and statistical measure to detect change from a previously observed state (Roy *et al*., 2005)

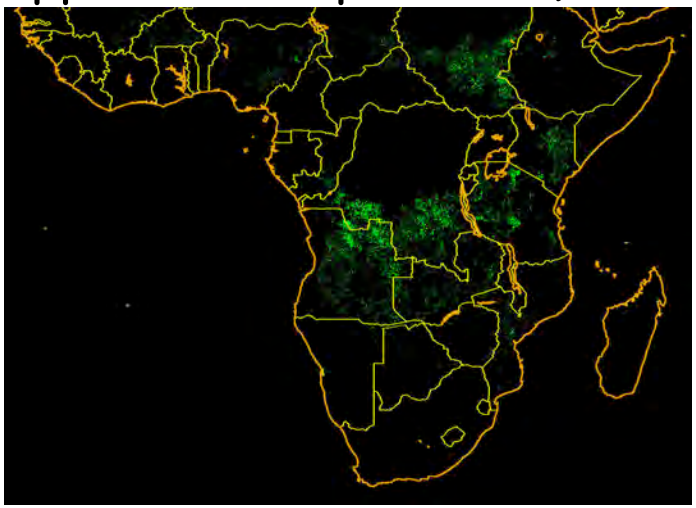
AVHRR 5km Burned Areas

Barbosa et al. 1999 (JRC)

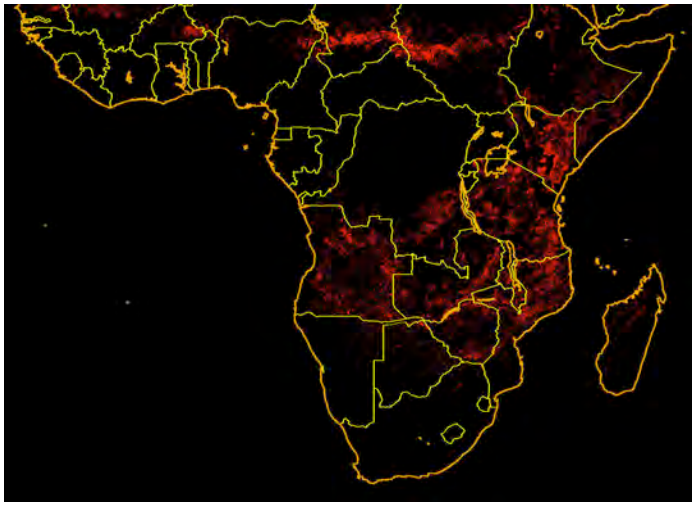
(decrease in VI, increase in apparent temperature)



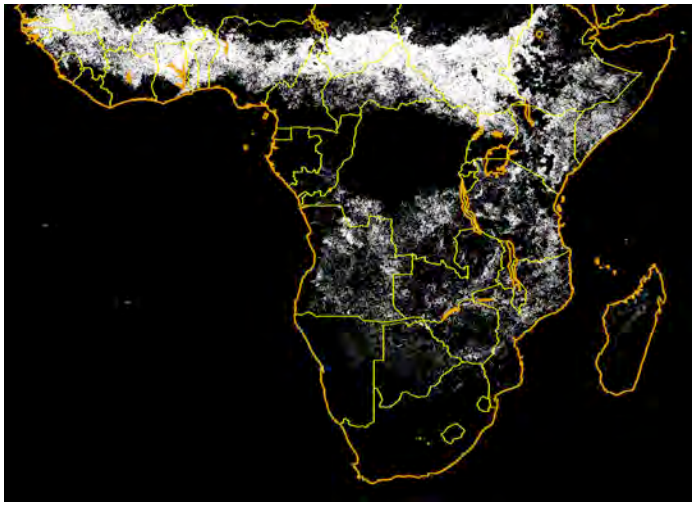
February - April 1987



May – July 1987



August – October 1987



November 1986 – October 1987

(Paulo Barbosa)

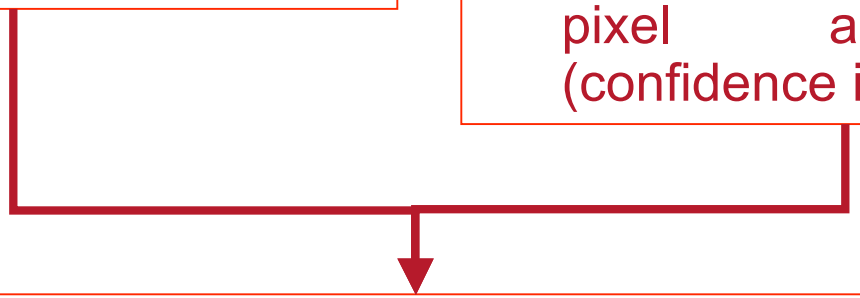
GLOBCARBON SPOT-ATSR-MERIS (ESA)

GBA-2000 (JRC)

- Original = 6 regional algorithms
- GLOBCARBON = 1 global and 2 regional algorithms
- it has associated with it confidence information (detection confidence from individual algorithms)

Globscar (ESA)

- Original = 2 global algorithms and burn when both agree.
- GLOBCARBON = each algorithm and sub-parts given a probability.
- The resulting probability determines occurrence of a pixel as burned (confidence information)

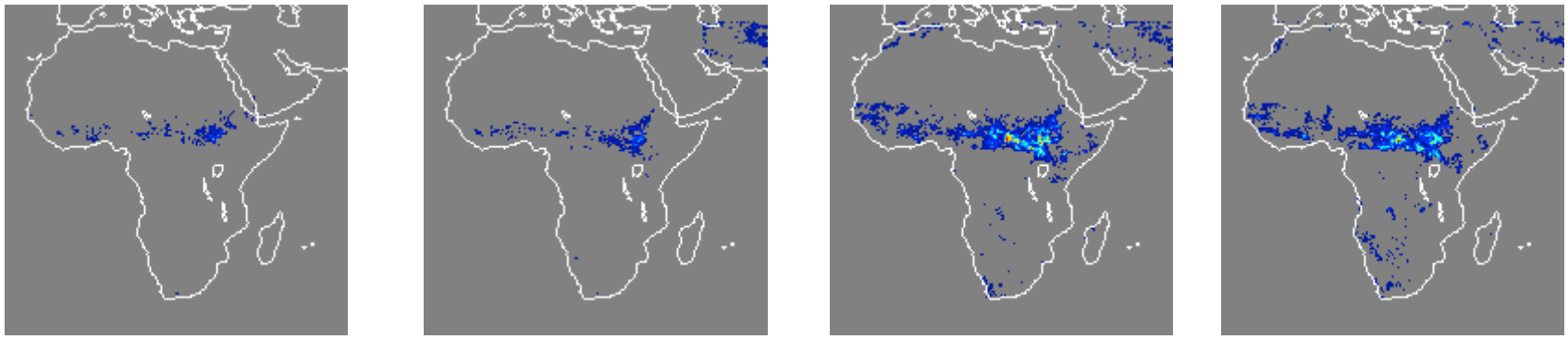


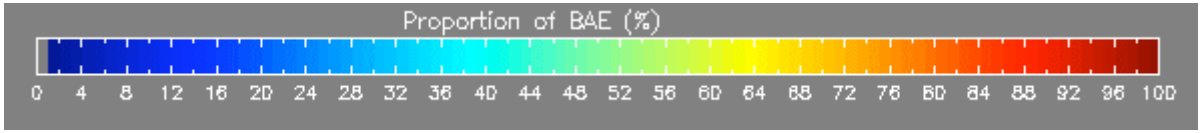
- Results are merged into one 1km product
- Collocation with available active fire products improves confidence

(S. Plummer)

GLOBCARBON January

1998 **1999** **2000** **2001**





Current version, regionally implausible overestimates of area burned

(Olivier Arino)

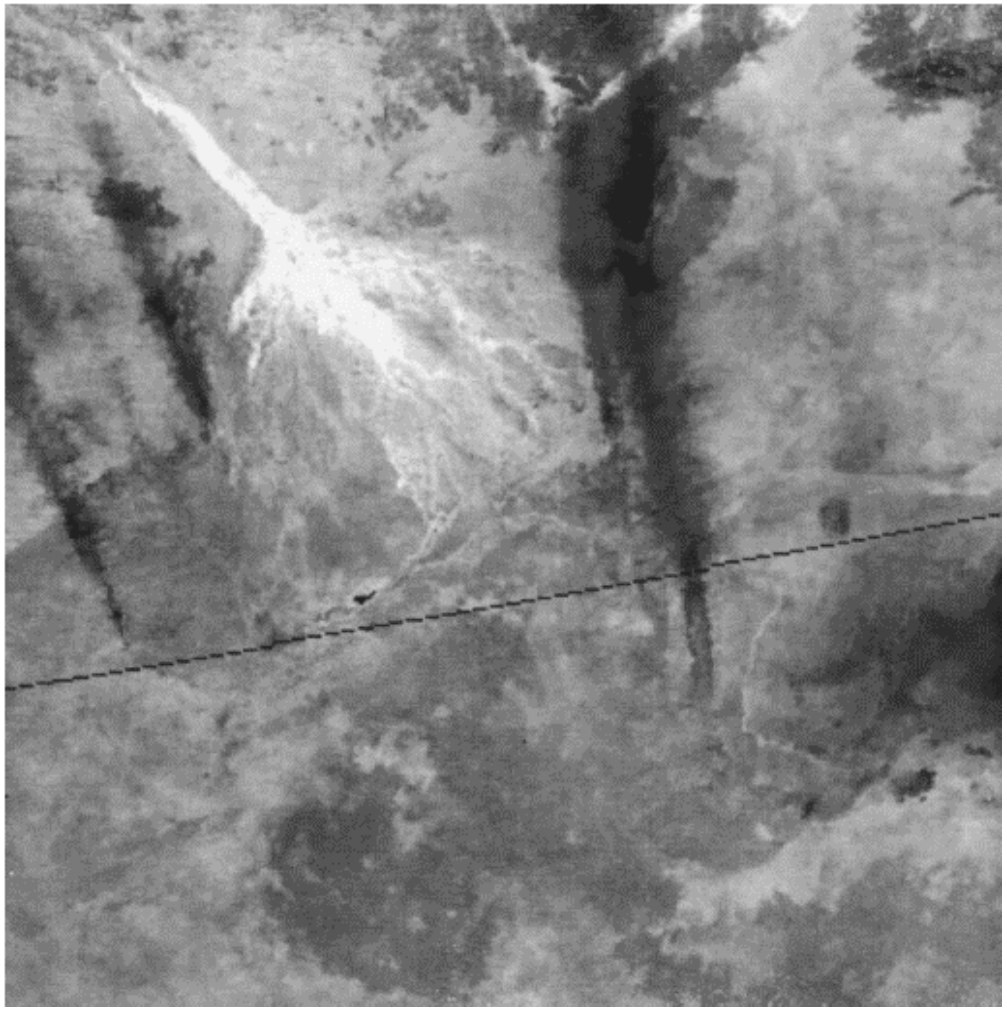
What is Promising about the LTDR for Burned Area Mapping

- State of the practice AVHRR pre-processing
  - Calibration
  - Geometric Correction
  - Atmospheric Correction
  - Cloud Screening
  - *Consistency cross the NOAA AVHRR series*

- New, AVHRR LTDR products
  - Reflective component of the middle infrared
  - Surface temperature

NDVI, 6 September 1989

NOAA-11 AVHRR 1.1 km pixels



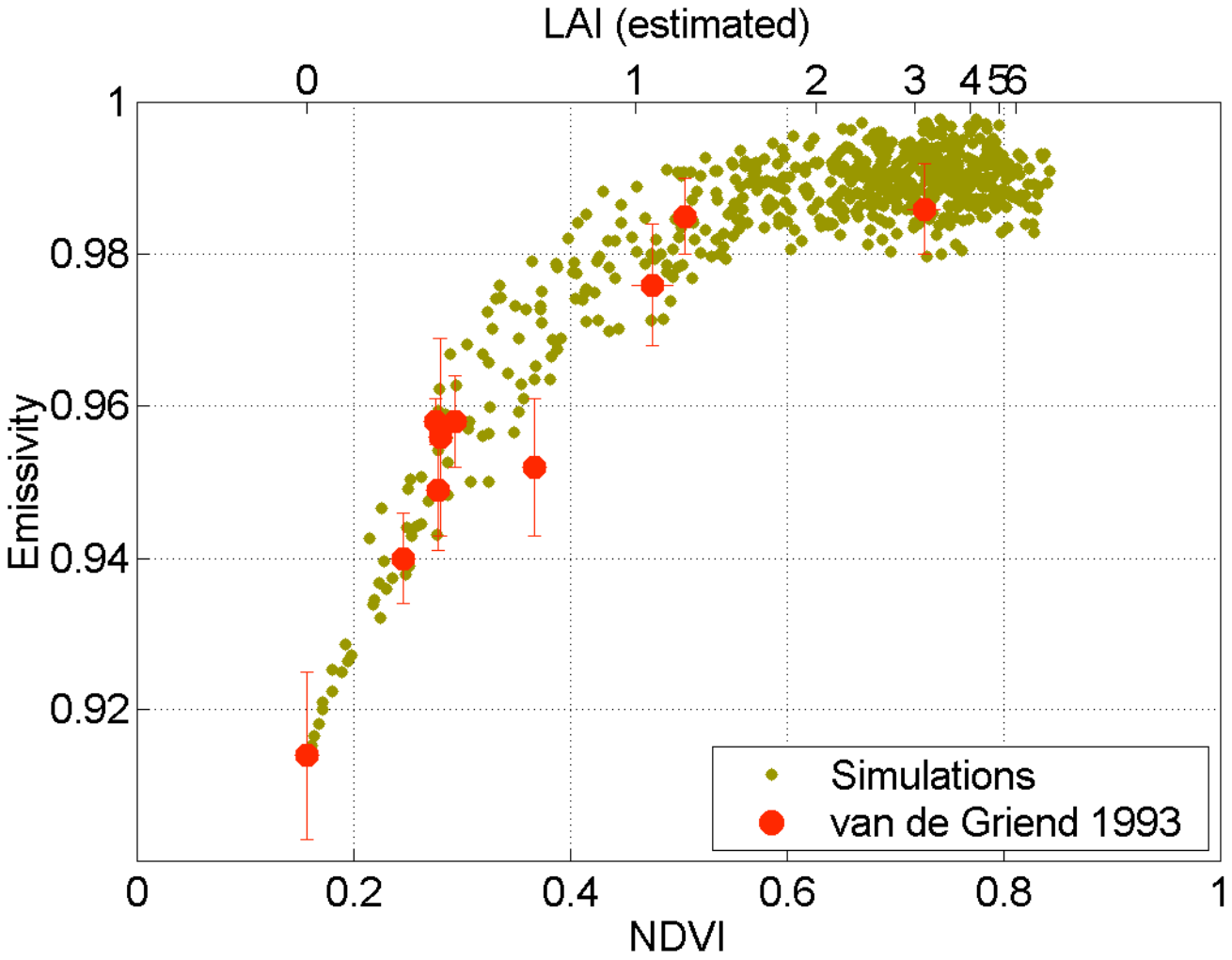
360 x 360km

VI3, 6 September 1989
NOAA-11 AVHRR 1.1 km pixels

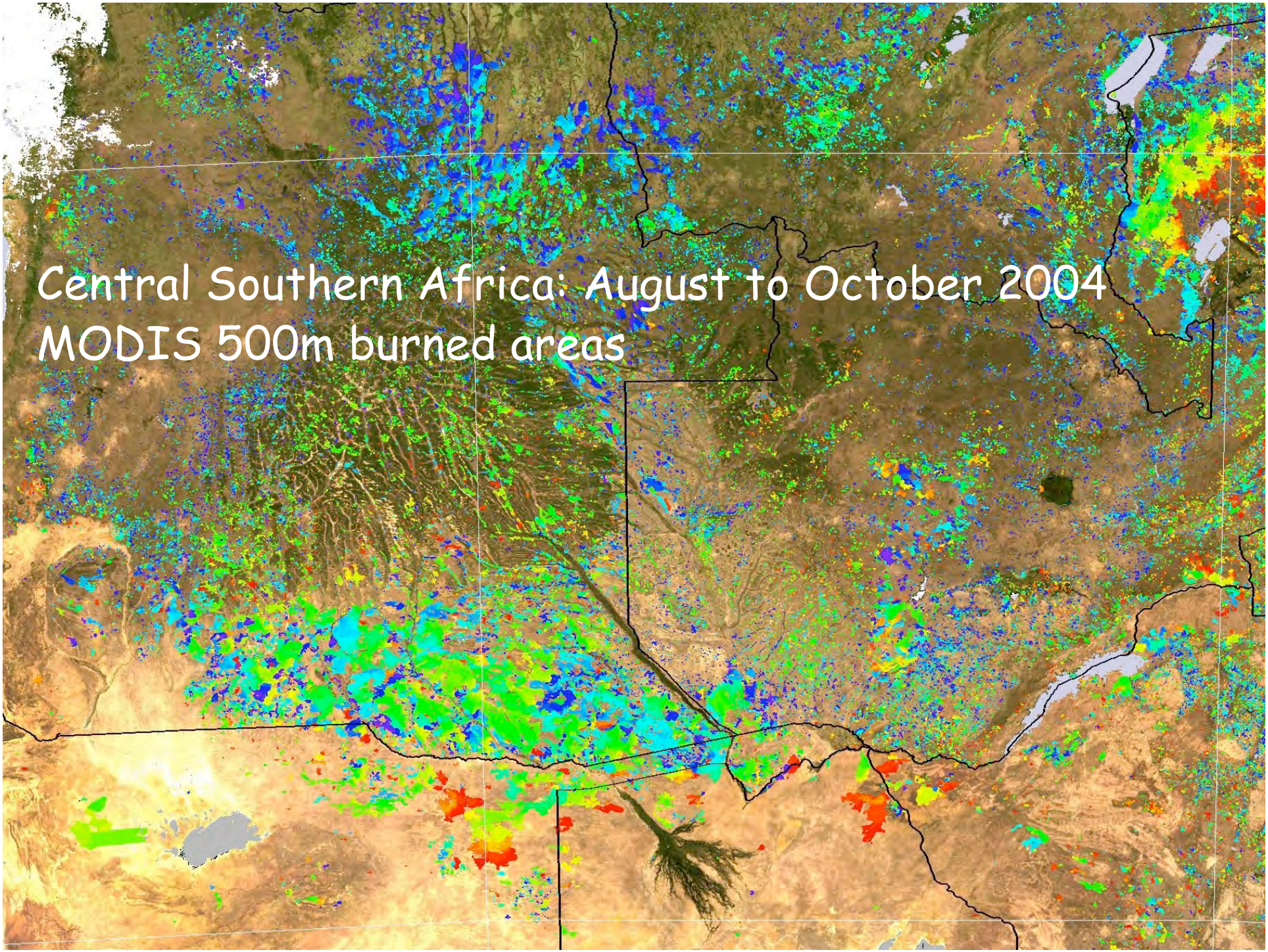
$VI3 = (\rho_2 - \rho_3)/(\rho_2 + \rho_3)$

360 x 360km

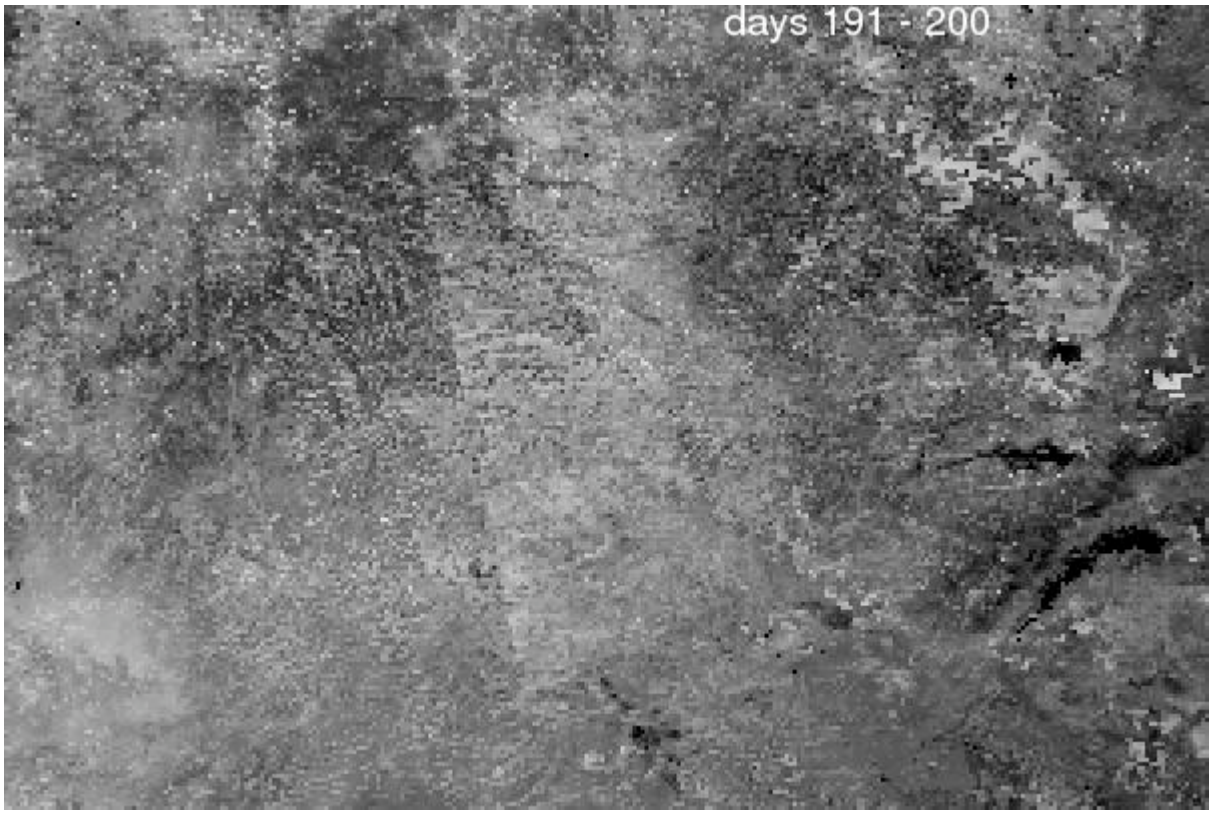
van de Griend and Owe 1993 (8-14 µm)



(A. Olioso)


Central Southern Africa: August to October 2004
MODIS 500m burned areas

10 ten day max. BT3 composites
BT3: 191-290, 201-210, …, 281 - 290

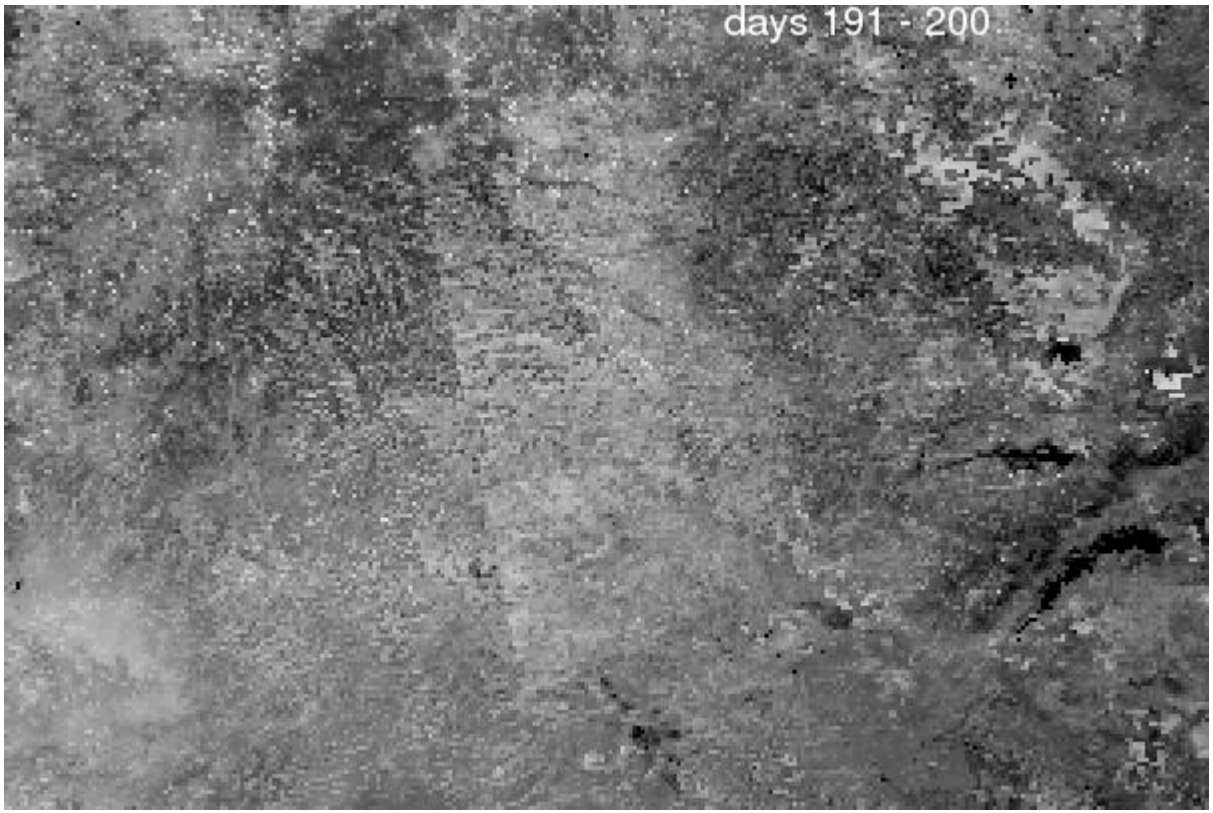


1999 AVHRR LTDR

Animation contrast stretch:

black=295K, white=320K

91 rolling ten day max. BT3 composites
BT3: 191-290, 192-291, …281 - 290



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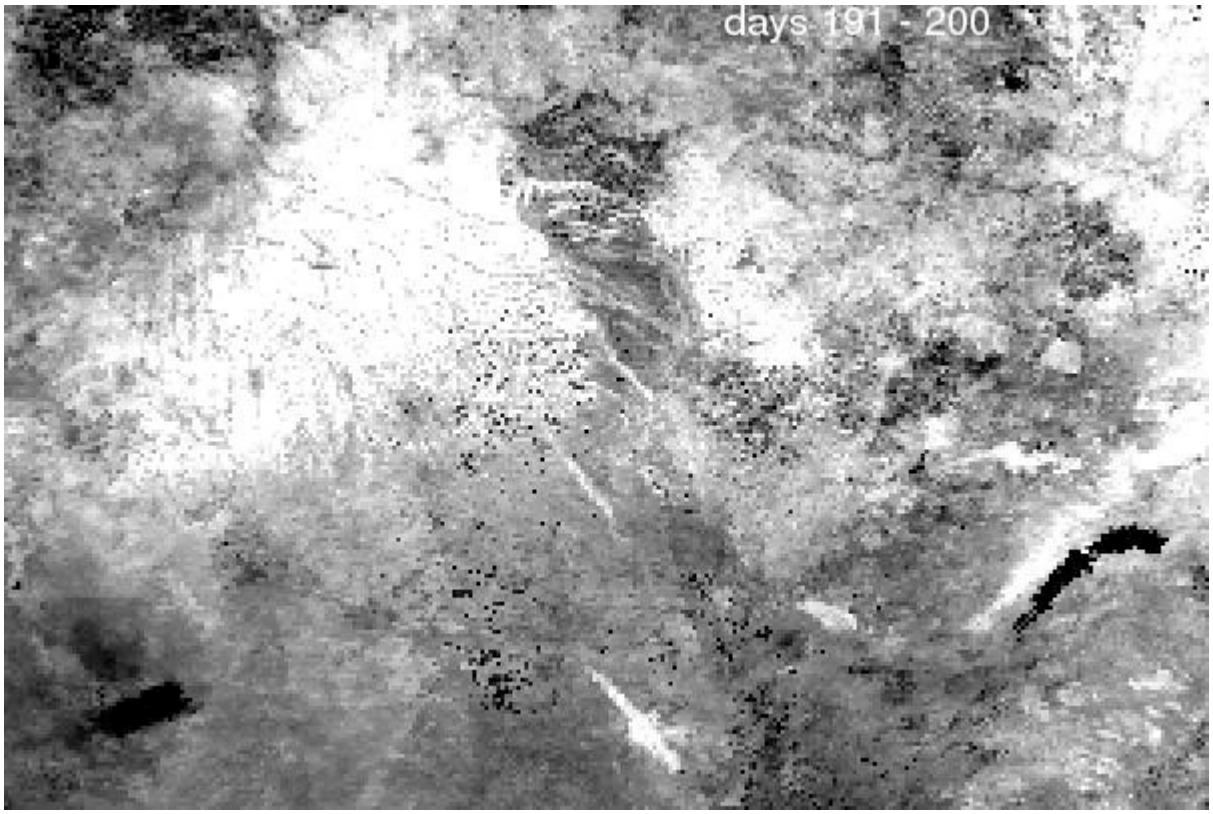
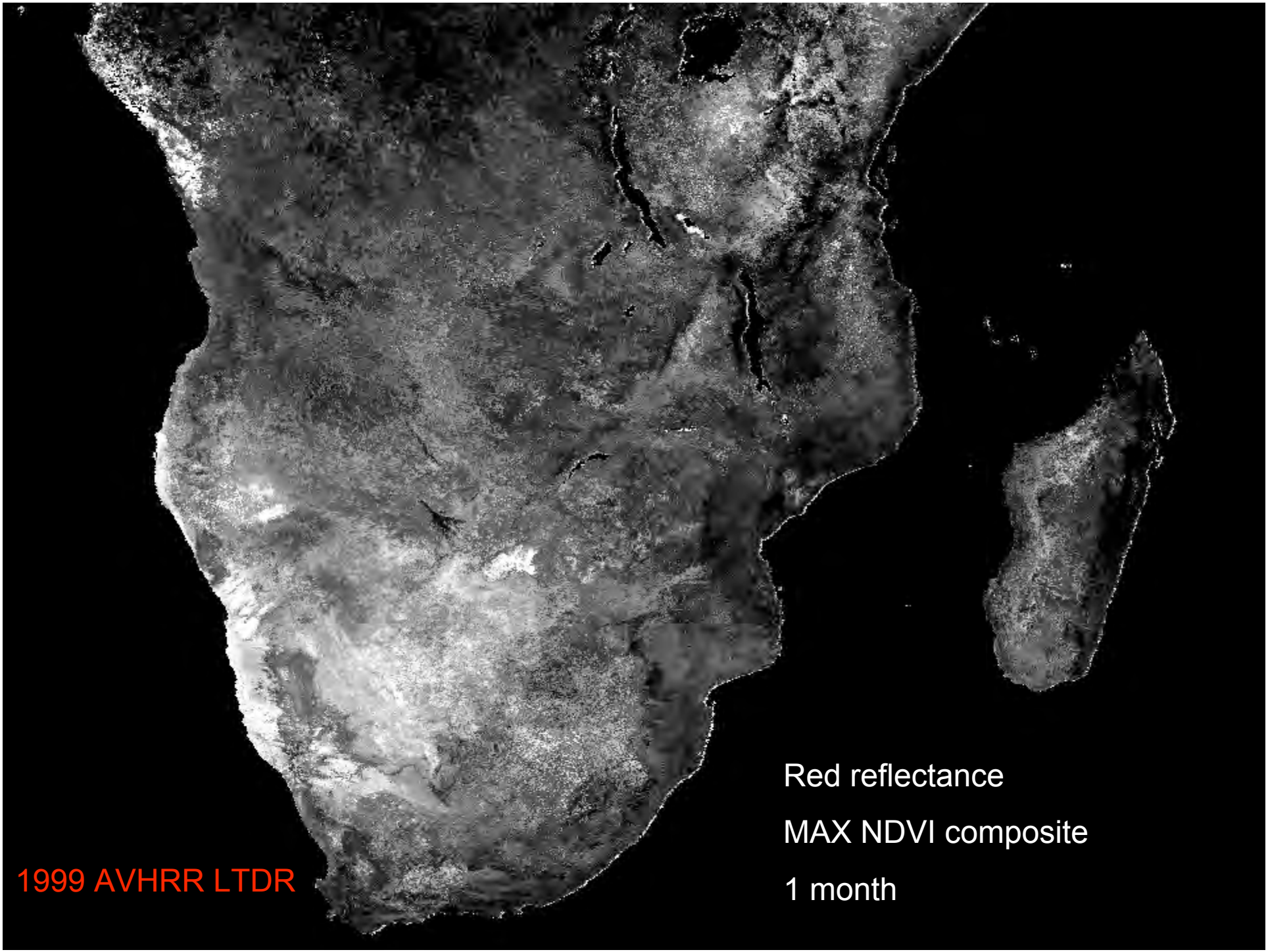
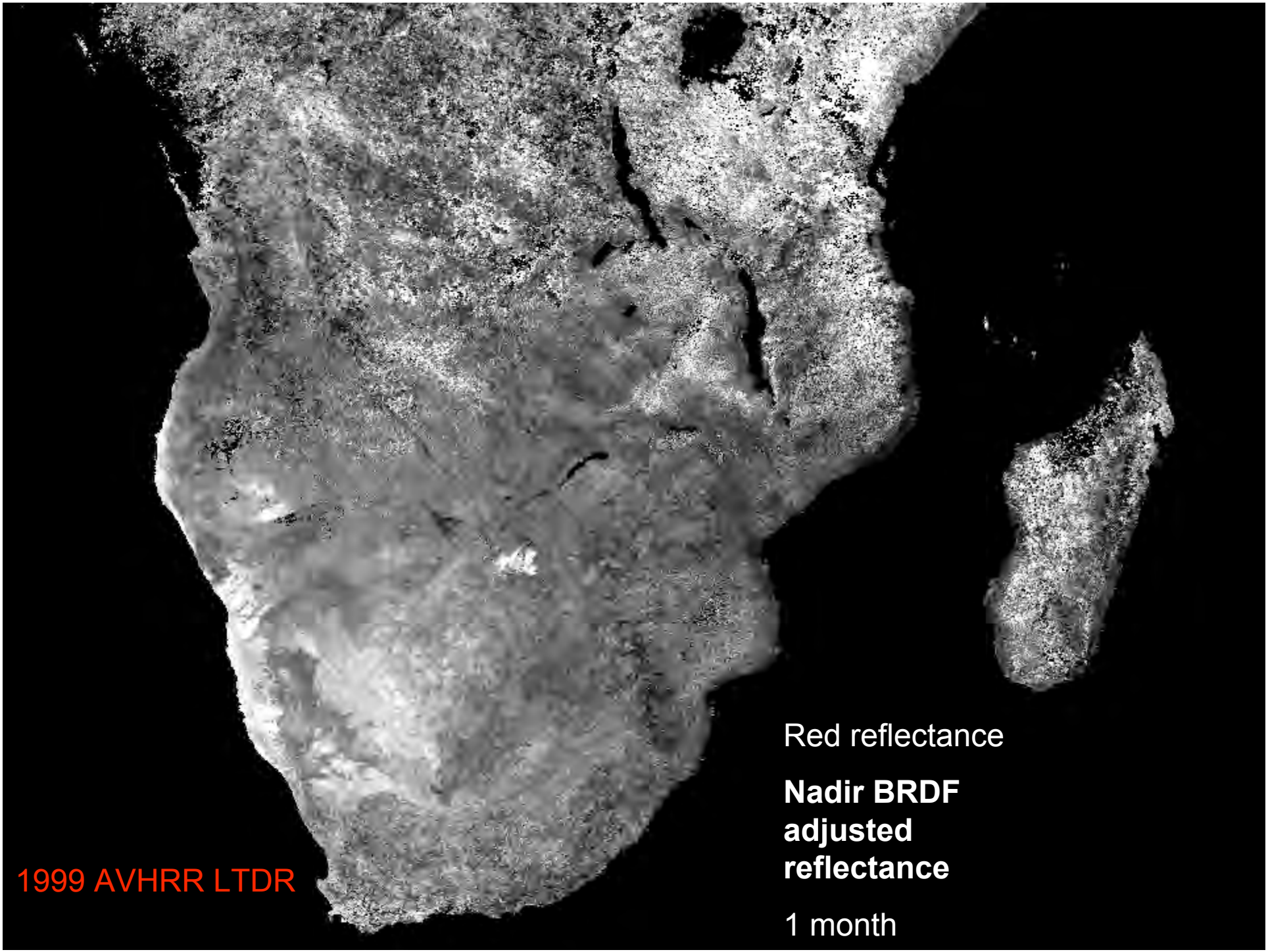


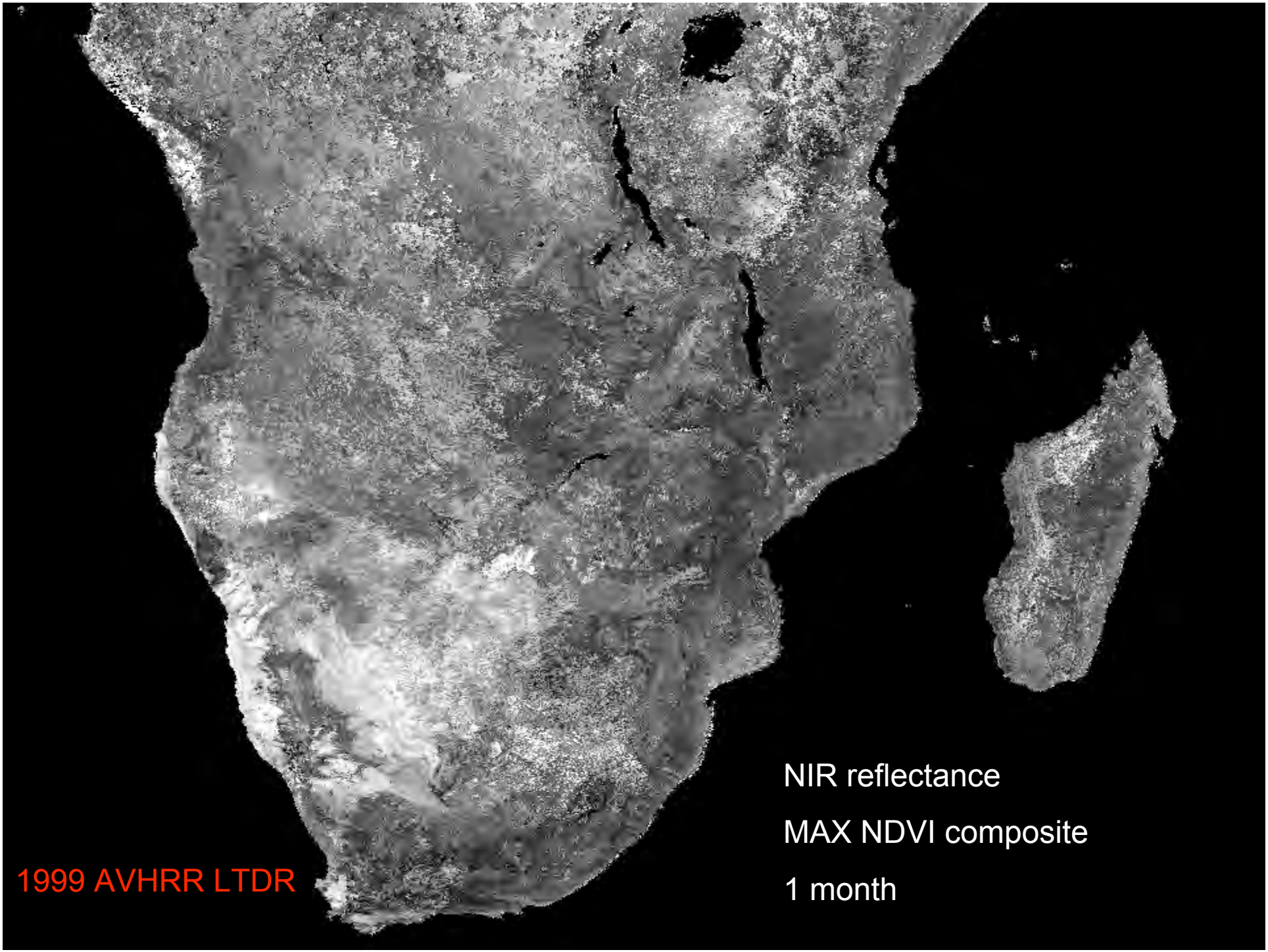
1999 AVHRR LTDR

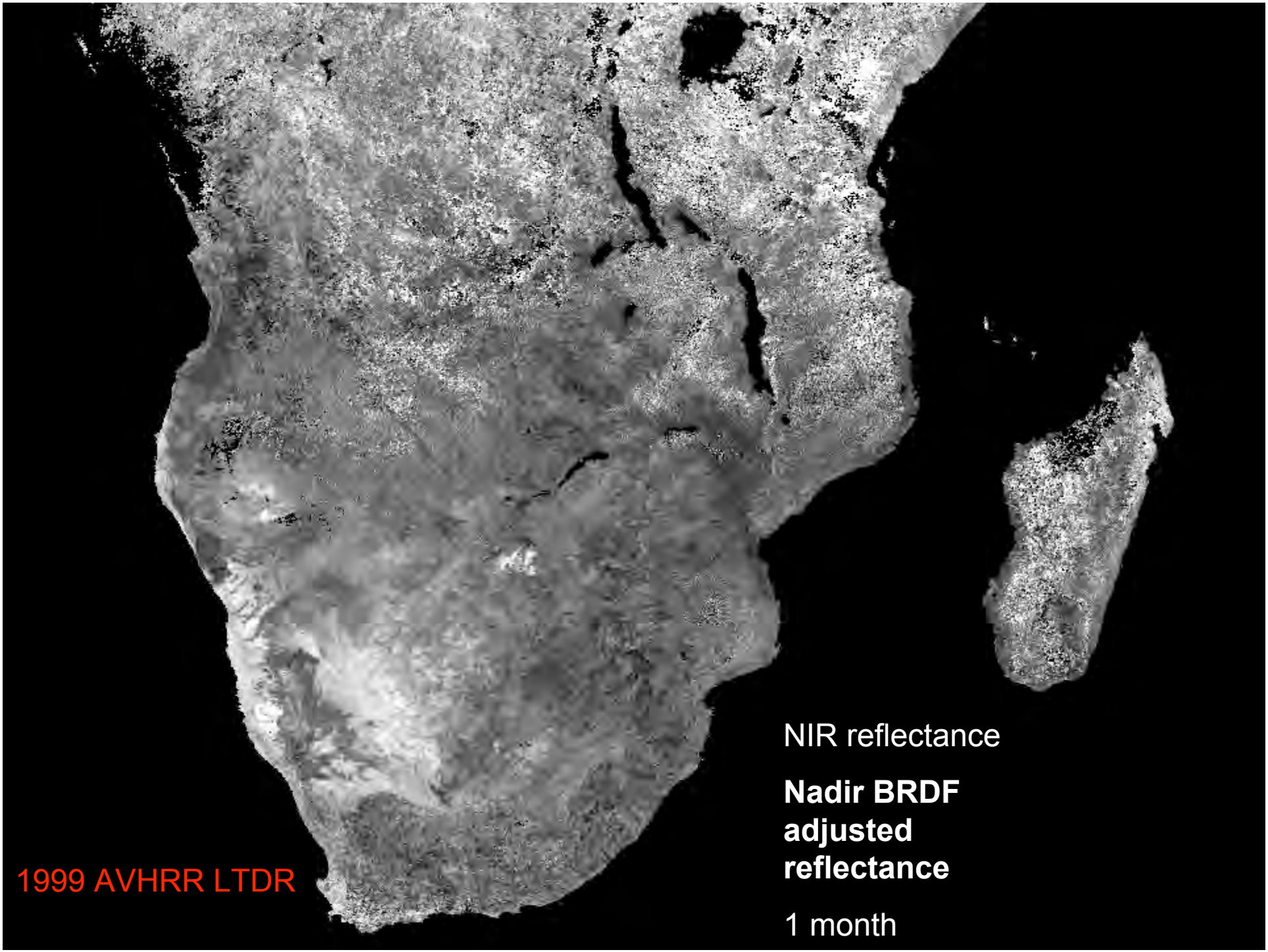
Animation Contrast stretch:

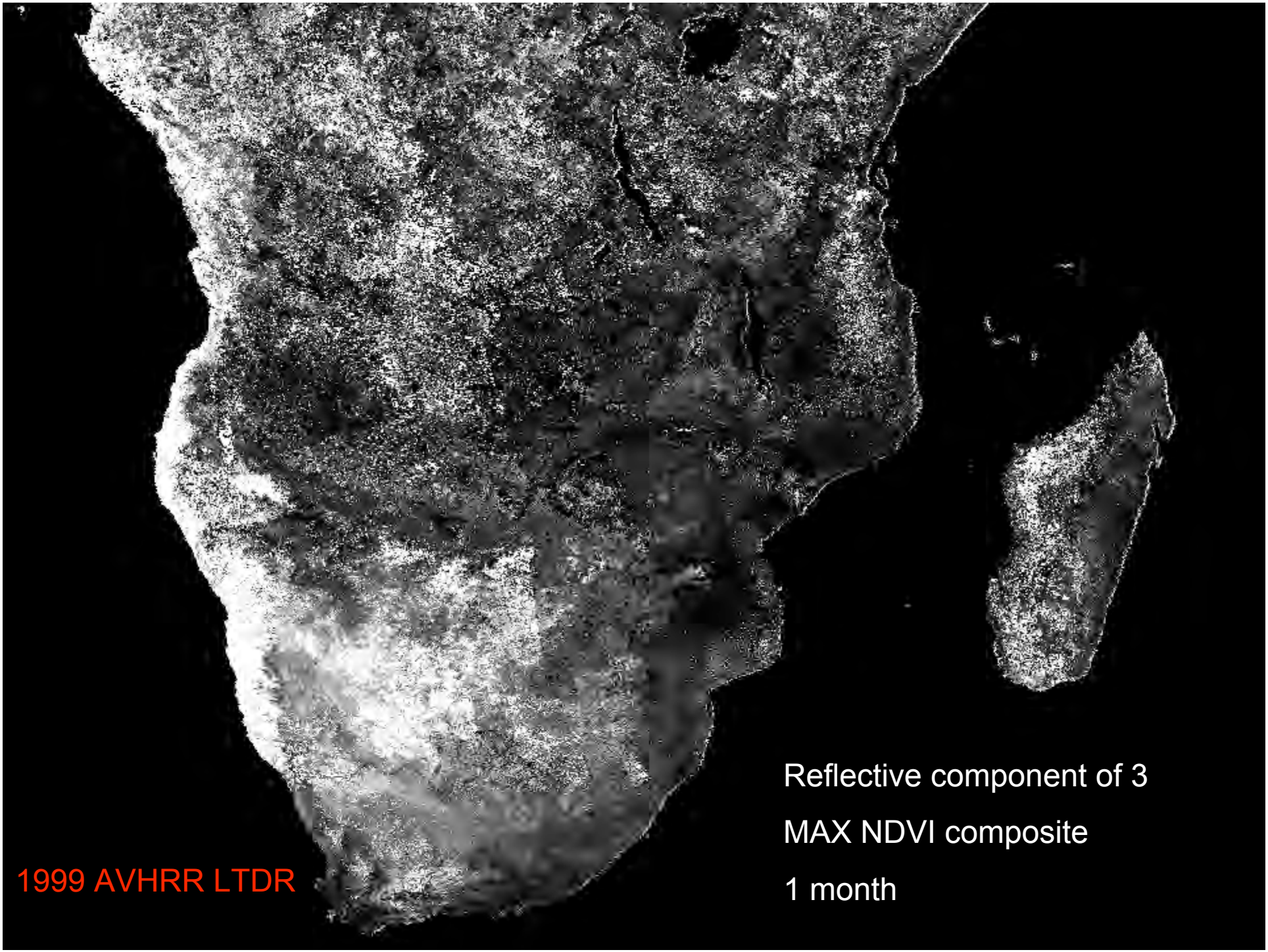
black=0.12, white=0.46

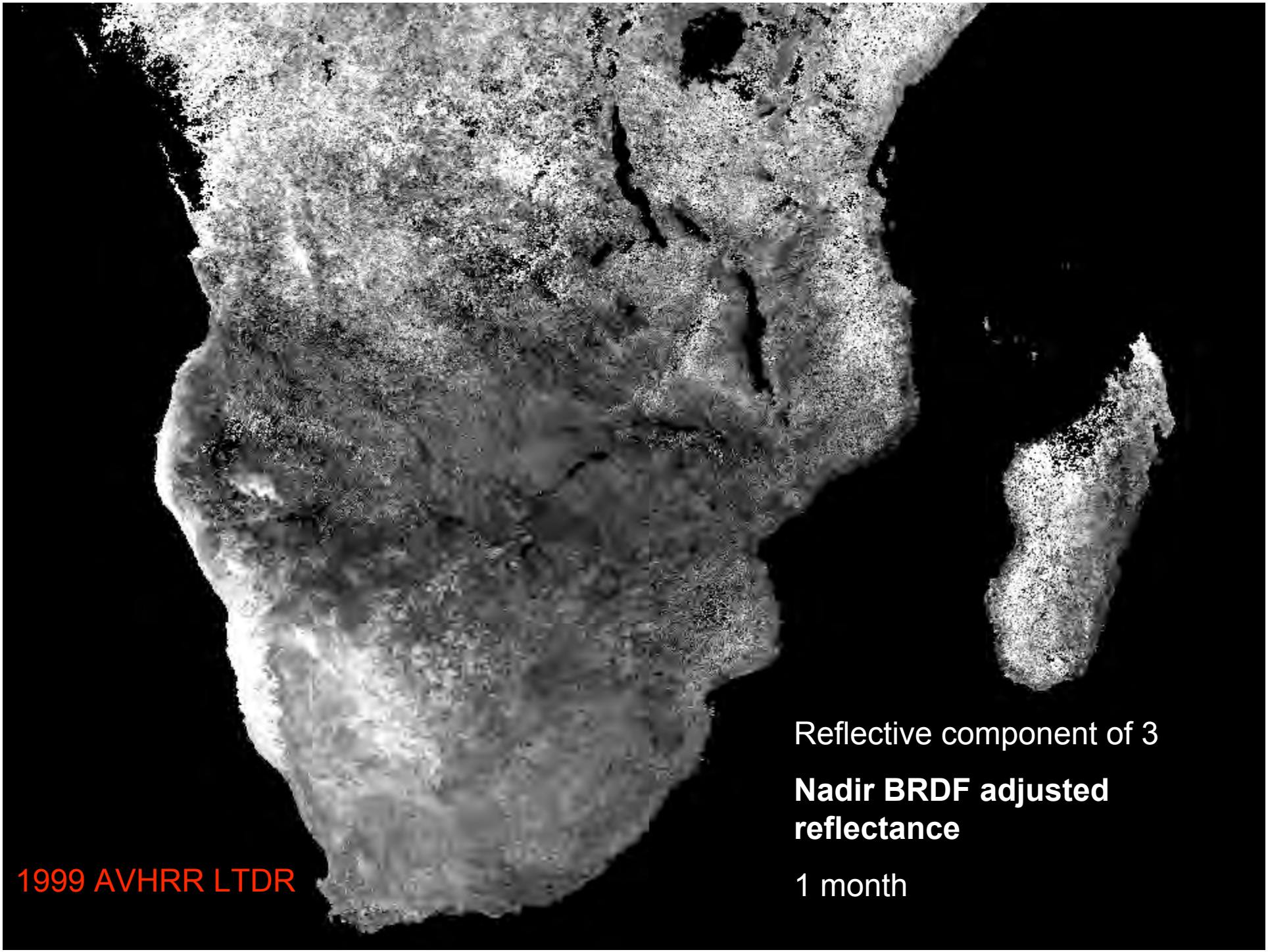

1999 AVHRR LTDR
Red reflectance
MAX NDVI composite
1 month

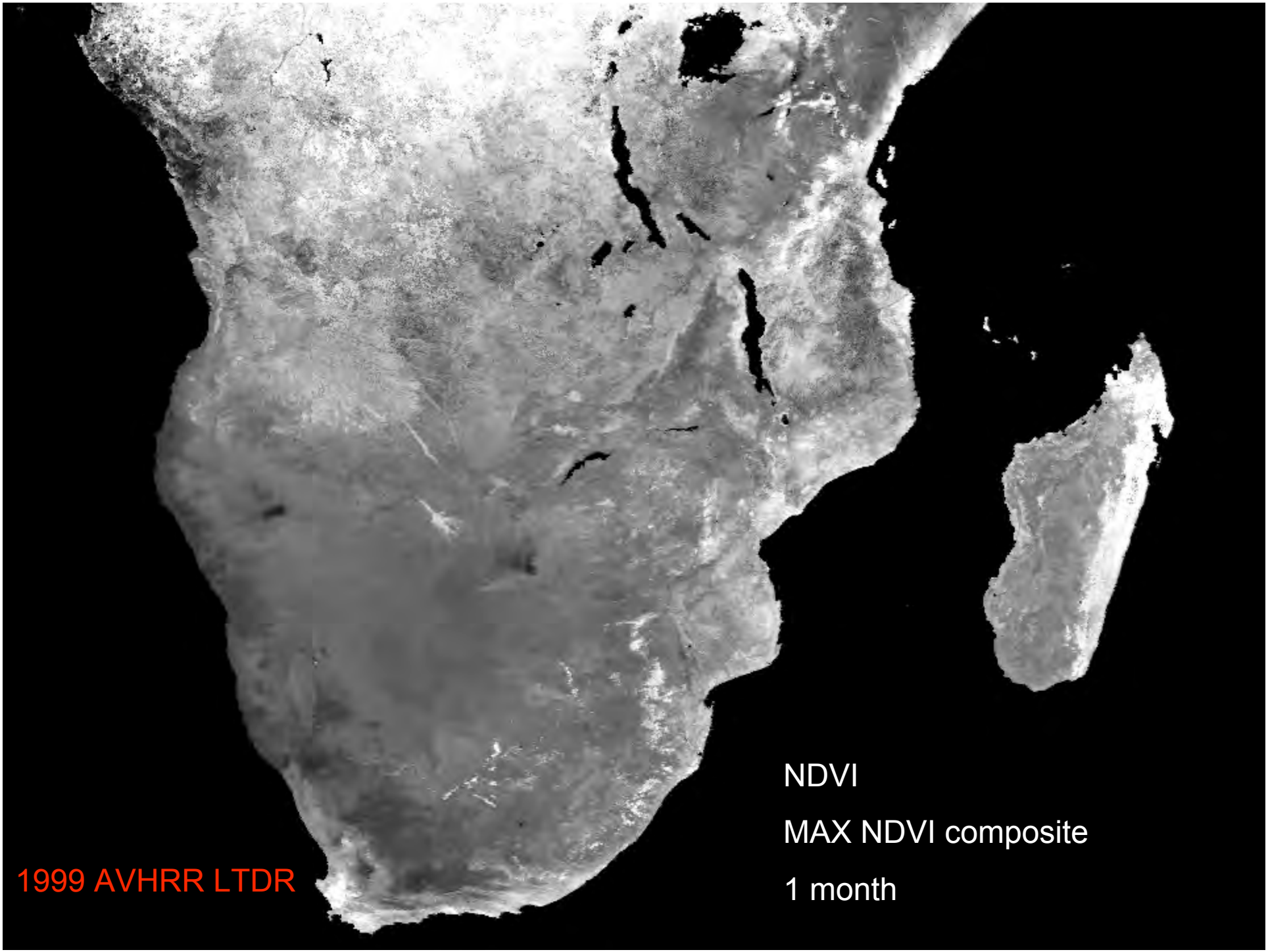

Red reflectance
Nadir BRDF adjusted reflectance
1 month
1999 AVHRR LTDR

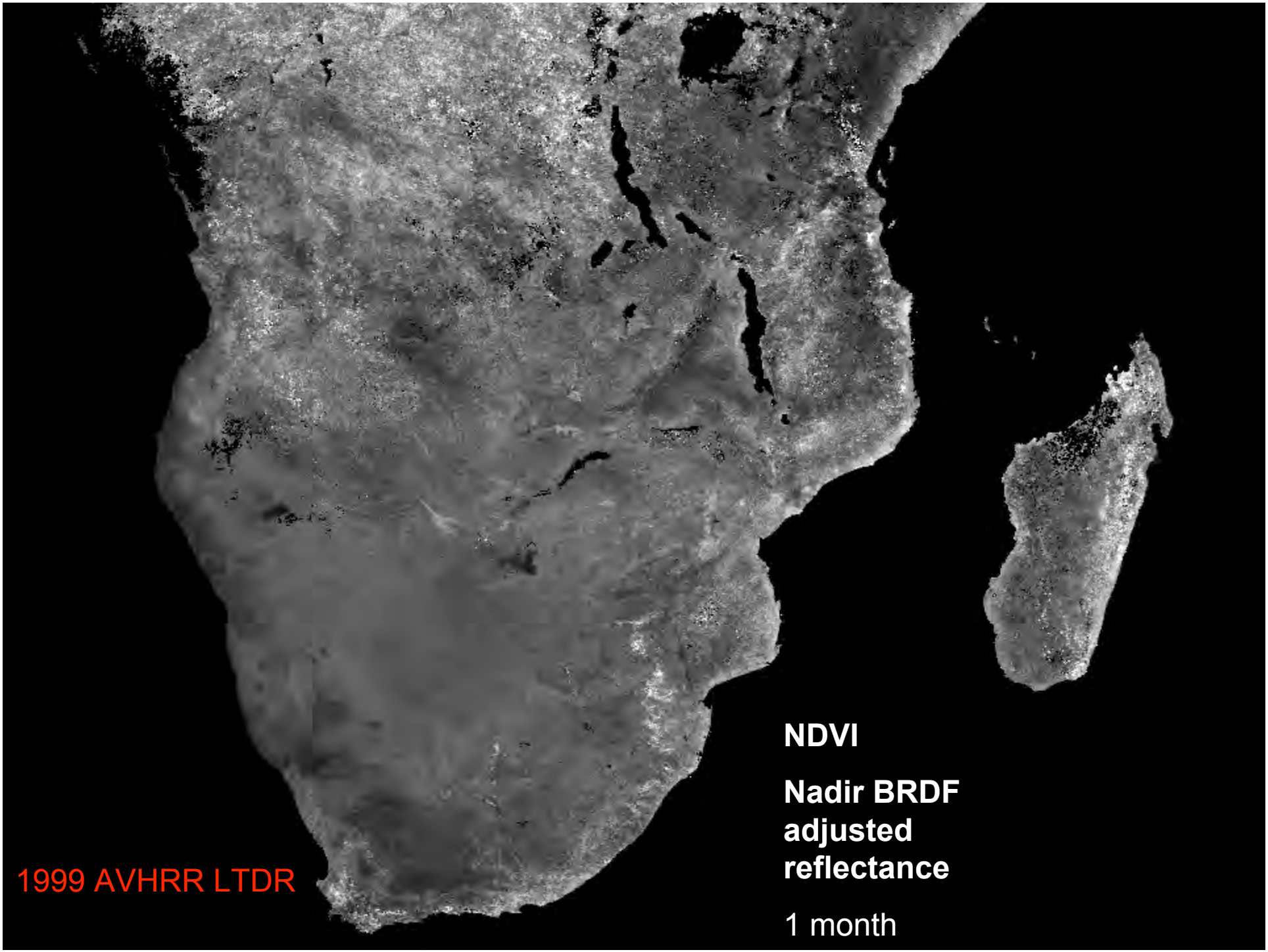

1999 AVHRR LTDR
NIR reflectance
MAX NDVI composite
1 month

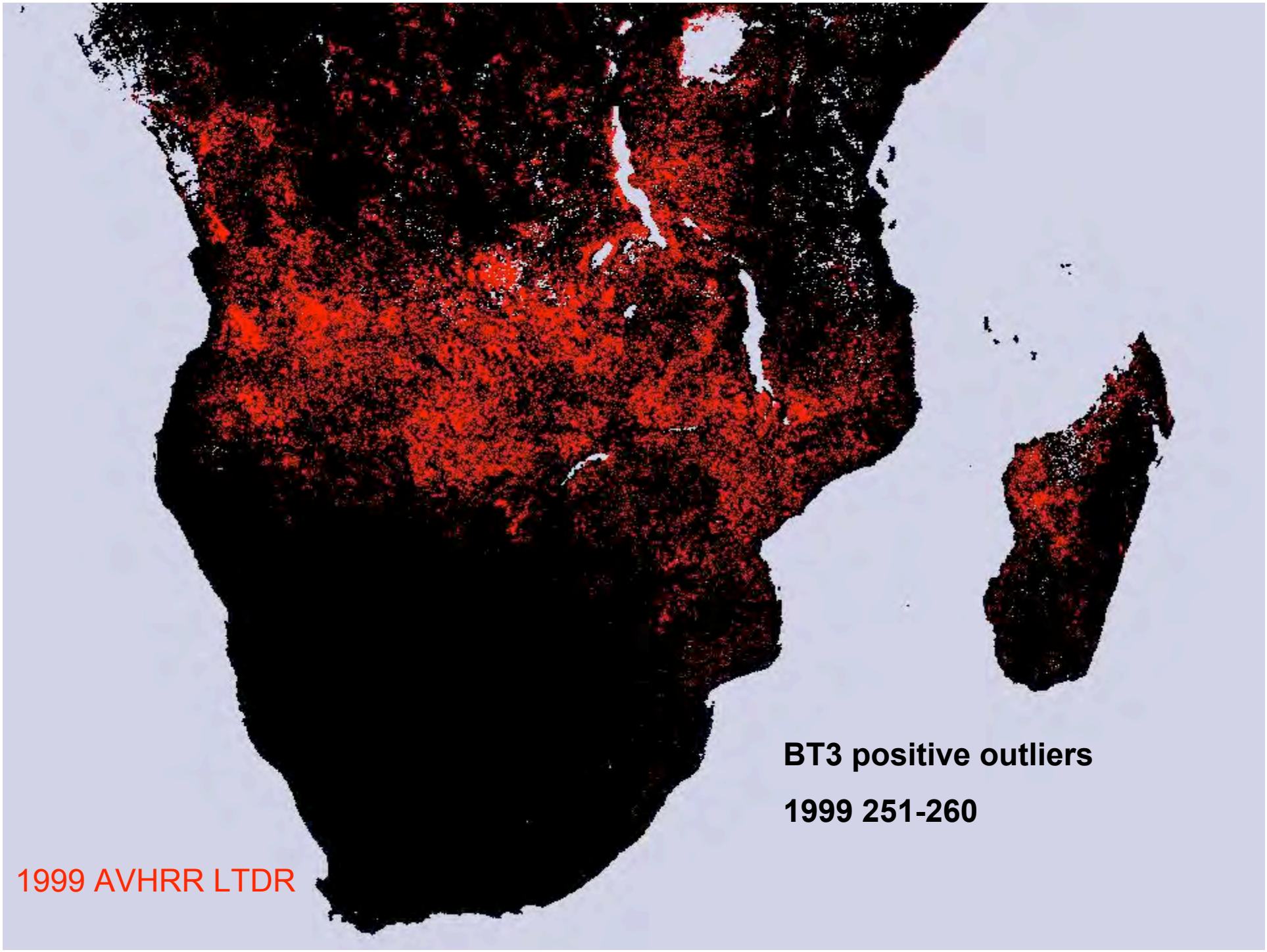

NIR reflectance
Nadir BRDF adjusted reflectance
1 month
1999 AVHRR LTDR

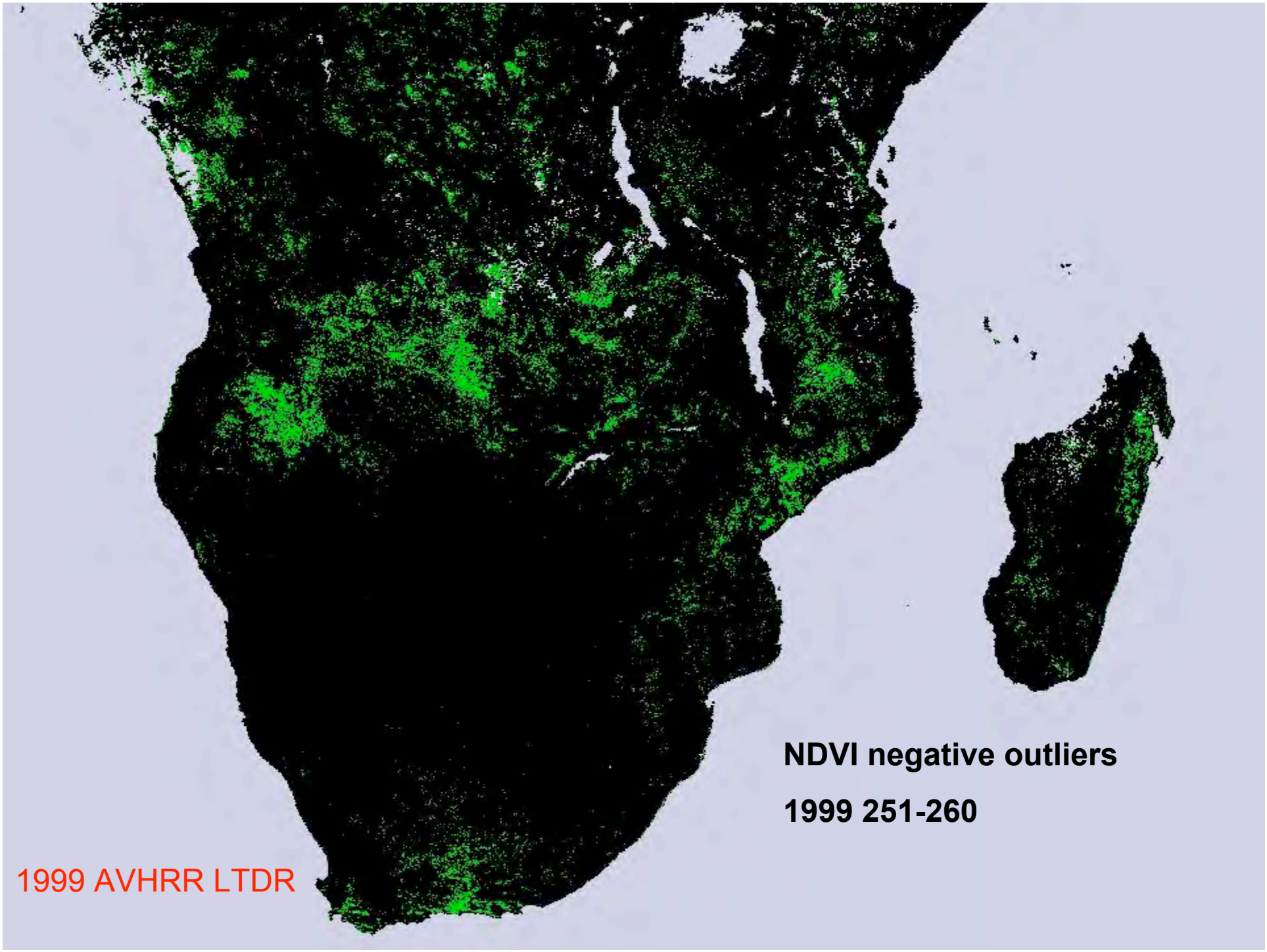

1999 AVHRR LTDR
Reflective component of 3
MAX NDVI composite
1 month


Reflective component of 3
Nadir BRDF adjusted reflectance
1 month
1999 AVHRR LTDR


NDVI
MAX NDVI composite
1 month
1999 AVHRR LTDR


1999 AVHRR LTDR
NDVI
Nadir BRDF adjusted reflectance
1 month


BT3 positive outliers
1999 251-260
1999 AVHRR LTDR


NDVI negative outliers
1999 251-260
1999 AVHRR LTDR

Next Steps

- Continue algorithm development
  - BRDF rolling compositing approaches
  - Surface temperature & ρ_3
  - Africa then Global
- Waiting for
  - aerosol correction
  - land surface temperature product
  - multi-annual data set
- Produce monthly and 10 day area burned estimates at 0.05 degree resolution
- Product comparison with other burned area products
  - 2000+ MODIS (NASA) 500m MODIS, reporting at 500m, near daily
  - 1998-2003 GLOBCARBON (ESA) 1km SPOT & ATSR, reporting at 10km, monthly
  - 1982-1999 GBS (JRC) AVHRR 8km PAL, although only derived seasonal fire probability data available to public